UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

Mr. Larry Lawson, Director
Division of Water Program Coordination
Virginia Department of Environmental Quality
629 Main Street
Richmond, VA 23219

Dear Mr. Lawson:

The Environmental Protection Agency (EPA) Region III is pleased to approve the Total Maximum Daily Loads (TMDLs) for the aquatic life (benthic) and primary contact use impairments on Abrams and Opequon Creek. The TMDLs were submitted to EPA for review in December 2003. The TMDLs were established and submitted in accordance with Section 303(d)(1)(c) and (2) of the Clean Water Act to address an impairment of water quality as identified in Virginia's 1998, Section 303(d) list.

In accordance with Federal regulations at 40 CFR §130.7, a TMDL must comply with the following requirements: (1) designed to attain and maintain the applicable water quality standards, (2) include a total allowable loading and as appropriate, wasteload allocations (WLAs) for point sources and load allocations for nonpoint sources, (3) consider the impacts of background pollutant contributions, (4) take critical stream conditions into account (the conditions when water quality is most likely to be violated), (5) consider seasonal variations, (6) include a margin of safety (which accounts for uncertainties in the relationship between pollutant loads and instream water quality), (7) consider reasonable assurance that the TMDL can be met, and (8) be subject to public participation. The enclosure to this letter describes how the TMDLs for the aquatic life and primary contact use impairments satisfy each of these requirements.

Following the approval of these TMDLs, Virginia shall incorporate the TMDLs into the Water Quality Management Plan pursuant to 40 CFR § 130.7(d)(2). As you know, all new or revised National Pollutant Discharge Elimination System permits must be consistent with the TMDL WLA pursuant to 40 CFR §122.44 (d)(1)(vii)(B). Please submit all such permits to EPA for review as per EPA's letter dated October 1, 1998.

If you have any questions or comments concerning this letter, please don't hesitate to contact Mr. Peter Gold at (215) 814-5236.

Sincerely,

Jon M. Capacasa, Director
Water Protection Division

Enclosure

Decision Rationale

**Total Maximum Daily Loads for
the Primary Contact Use (Bacteriological) Impairments on Abrams and Opequon Creek**

I. Introduction

The Clean Water Act (CWA) requires a Total Maximum Daily Load (TMDL) be developed for those water bodies identified as impaired by a state where technology-based and other controls will not provide for attainment of water quality standards. A TMDL is a determination of the amount of a pollutant from point, nonpoint, and natural background sources, including a margin of safety (MOS), that may be discharged to a water quality-limited water body.

This document will set forth the Environmental Protection Agency's (EPA) rationale for approving the TMDLs for the primary contact use (bacteriological) impairments on Abrams and Opequon Creek. EPA's rationale is based on the determination that the TMDLs meet the following eight regulatory conditions pursuant to 40 CFR §130.

1) The TMDLs are designed to implement applicable water quality standards.
2) The TMDLs include a total allowable load as well as individual waste load allocations and load allocations.
3) The TMDLs consider the impacts of background pollutant contributions.
4) The TMDLs consider critical environmental conditions.
5) The TMDLs consider seasonal environmental variations.
6) The TMDLs include a margin of safety.
7) There is reasonable assurance that the TMDLs can be met.
8) The TMDLs have been subject to public participation.

II. Background

The Abrams and Opequon Creek Watersheds are located in Clarke and Frederick County, Virginia. The Abrams Creek Watershed is 12,278-acres in size and is a tributary to Opequon Creek. The impaired segment of Abrams Creek begins at the headwaters and terminates at its confluence with Opequon Creek. The Opequon Creek Watershed is 43,806-acres in size and encompasses the Upper and Lower Opequon Creek Watersheds and the Abrams Creek Watershed. The Upper Opequon Creek is impaired from its headwaters to its confluence with Abrams Creek a distance of approximately 22 river miles. The Lower Opequon Creek is the portion of the watershed downstream of the confluence with Abrams Creek. Lower Opequon Creek also failed to attain the primary contact use due to violations of the bacteriological criteria. The impaired segment runs a distance of approximately 8 miles originating at the confluence with Abrams Creek and terminating at the West Virginia state line.

Abrams Creek is the most urbanized of the three watersheds. The watershed houses the City of Winchester and 50% of its landuses would be classified as urban. The remainder of the watershed is split between agricultural (22%) and forested (27%) lands. The Upper Opequon watershed is more rural with only 14% of its lands classified as urban. The Upper Opequon watershed is composed of mainly agricultural (50%) and forested (33%) lands. The Lower Opequon watershed is similar to the Upper Opequon in land uses with agriculture and forests making up 50% and 29% of the watershed respectively. The remainder of the Lower Opequon watershed is made up of urban (19%) lands.

In response to Section 303(d) of the CWA, the Virginia Department of Environmental Quality (VADEQ) listed 10.38 miles of Abrams Creek (VAV-B09R) on Virginia's 1998 Section 303(d) list as being unable to attain its aquatic life and primary contact uses. The 8.73 mile segment of Lower Opequon Creek (VAV-B09R) was impaired for the same parameters on Virginia's 1998 Section 303(d) list. The 22.44 mile segment of Upper Opequon Creek (VAV-B08R) was listed for failing to attain the primary contact use. This decision rationale will address the TMDLs for the impairment of the primary contact use. Separate TMDLs were developed for the benthic impairments on Abrams and Lower Opequon Creek.

All of these Creeks were listed for violations of Virginia's fecal coliform water quality criteria. Fecal coliform is a bacterium which can be found within the intestinal tract of all warm blooded animals. Therefore, fecal coliform can be found in the fecal wastes of all warm blooded animals. Fecal coliform in itself is not a pathogenic organism. However, fecal coliform indicates the presence of fecal wastes and the potential for the existence of other pathogenic bacteria. The higher concentrations of fecal coliform indicate the elevated likelihood of increased pathogenic organisms.

EPA has been encouraging the states to use e-coli and enterococci as the indicator species instead of fecal coliform. A better correlation has been drawn between the concentrations of e-coli and enterococci, and the incidence of gastrointestinal illness. The Commonwealth has adopted e-coli and enterococci criteria. Streams will be evaluated via the e-coli and enterococci criteria after 12 samples have been collected using these indicator species. The fecal coliform criteria will be used in the interim.

As Virginia designates all of its waters for primary contact, all waters must meet the current fecal coliform standard for primary contact. Virginia's standard applies to all streams designated as primary contact for all flows. The fecal coliform criteria was modified in 2002 to require that the fecal coliform concentration not exceed a geometric mean of 200 colony forming units (cfu) per 100 milliliters (mL) of water for 2 or more samples collected over a month nor shall more than 10% of the total samples exceed 400 cfu/100 mL of water. The new e-coli criteria requires a geometric mean concentration of 126 cfu/100mL of water with no sample exceeding 235 cfu/100 mL of water. Unlike the fecal coliform criteria which allows a 10% violation rate the new e-coli criteria requires the concentration of e-coli not exceed 235 cfu/ 100mL of water.

Although, the TMDL and criteria require the 235 cfu/ 100 mL of water not to be exceeded waters are not placed on the Section 303(d) list if their violation rate does not exceed 10%. Therefore, the Creeks may be deemed as attaining their uses prior to the implementation of all of the TMDL reductions. It is necessary to keep this in mind because of the reductions needed to attain the instantaneous criteria for e-coli. All three streams are or were very close to meeting the old criteria for fecal coliform.

The TMDLs submitted by Virginia are designed to determine the acceptable load of fecal coliform which can be delivered to the impaired waters, as demonstrated by the Hydrologic Simulation Program Fortran (HSPF)[1], in order to ensure that the water quality standard is attained and maintained. HSPF is considered an appropriate model to analyze these impaired waters because of its dynamic ability to simulate both watershed loading and receiving water quality over a wide range of conditions.

The TMDL analysis allocates the application/deposition of fecal coliform to land based and instream sources. For land based sources, the HSPF model accounts for the buildup and washoff of pollutants from these areas. Buildup (accumulation) refers to all of the complex spectrum of dry-weather processes that deposit or remove (die-off) pollutants between storms.[2] Washoff is the removal of fecal coliform which occurs as a result of runoff associated with storm events. These two processes allow the HSPF model to determine the amount of fecal coliform from land based sources which is reaching the stream. Point sources and wastes deposited directly to the stream were treated as direct deposits. Wastes which are deposited directly to the stream do not need a transport mechanism.

Local rainfall and temperature data were needed to develop the model. Weather data provides the rainfall data which drives the TMDL model. Hourly weather data was obtained from the Star Tannery weather station. There were some inconsistencies found between the observed runoff and observed precipitation data. Therefore, precipitation data was compared to precipitation data collected from the Winchester station, which is also located within the watershed. If there was a discrepancy between the data from these two stations, the Star Tannery station's data was modified to what was observed at the Winchester station.

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[1]Bicknell, B.R., J.C. Imhoff, J.L. Little, and R.C. Johanson. 1993. Hydrologic Simulation Program-FORTRAN (HSPF): User's Manual for release 10.0. EPA 600/3-84-066. U.S. Environmental Protection Agency, Environmental Research Laboratory, Athens, GA.

[2]CH2MHILL, 2000. Fecal Coliform TMDL Development for Cedar, Hall, Byers, and Hutton Creeks Virginia,

Stream flow data was available for both Abrams and Opequon Creek. A United States Geological Survey (USGS) gage was located in the mouths of both Abrams and Upper Opequon Creek. The USGS gages for both watersheds were operated from the 1940s to 1997. This gave an ample data period for calibration of the model. The calibration for Abrams Creek was from 1986 through 1988. The simulated results of the model were compared with observed data from USGS 01616000 on a seasonal and flow basis. The model represented the observed data very well and was within the percent error called for in the modeling software. The Abrams Creek model was validated for a separate five year period from 1980 through 1985. During the calibration the modelers may adjust the model parameters to more accurately represent the observed data. During the validation process the parameters are frozen to see how well the model represents observed conditions over a new time period. Once again, the Abrams Creek model represented the observed data very well.

Upper Opequon Creek was calibrated to observed data from USGS gage 01615000 just upstream of Upper Opequon's Creek's confluence with Abrams Creek. The model was calibrated to data from October 1987 through September 1992 and validated to data from October 1992 through September 1997. Once again the model performed very well and was within the acceptable percent error ranges. Since there was no independent gage on Lower Opequon Creek, the hydrology for the Lower Opequon used the parameters developed for Upper Opequon Creek. For additional information and results on the calibration and validation please refer to Section 5.0 of the TMDL report.

The TMDLs were modeled using fecal coliform loading rates as was done in previous TMDL efforts. The fecal coliform concentrations were then converted to E-Coli concentrations using a translator equation developed by VADEQ.

Table 1 - Summarizes the Specific Elements of the TMDLs.

Segment	Parameter	TMDL (cfu/yr)	WLA (cfu/yr)	LA (cfu/yr)	MOS
Abrams Creek	E-Coli	1.96E+13	0.31E+13	1.65E+13	Implicit
Upper Opequon	E-Coli	3.99E+13	0.35E+13	3.63E+13	Implicit
Lower Opequon	E-Coli	11.61E+13	2.13E+13	9.48E+13	Implicit

The United States Fish and Wildlife Service has been provided with copy of this TMDL.

III. Discussion of Regulatory Conditions

EPA finds that Virginia has provided sufficient information to meet all of the eight basic requirements for establishing a primary contact (bacteriological) impairment TMDLs for Abrams, Upper Opequon and Lower Opequon Creek. EPA is therefore approving these TMDLs. EPA's approval is outlined according to the regulatory requirements listed below.

1) The TMDLs are designed to meet the applicable water quality standards.

Virginia has indicated that excessive levels of fecal coliform due to nonpoint sources (both wet weather and directly deposited nonpoint sources) have caused violations of the water quality criteria and designated uses in the Abrams and Opequon Creek Watersheds. The water quality criterion for fecal coliform was a geometric mean 200 cfu/100mL or an instantaneous standard of no more than 1,000 cfu/100ml. Two or more samples over a 30 day period are required for the geometric mean standard. Since the state rarely collects more than one sample over a thirty-day period, most of the samples were measured against the instantaneous standard. The Commonwealth has changed its bacteriological criteria as indicated above. The new criteria require that the fecal coliform concentration not exceed a geometric mean of 200 cfu per 100 milliliters of water for two or more samples collected over a month nor shall more than 10% of the total samples exceed 400 cfu/100 mL of water. The new e-coli criteria requires a geometric mean of 126 cfu/100mL of water with no sample exceeding 235 cfu/100 mL.

The HSPF model is being used to determine the fecal coliform deposition rates to the land as well as loadings to the stream from point and other direct deposit sources necessary to support the new fecal coliform and e-coli water quality criterion and primary contact use. The following discussion is intended to describe how controls on the loading of fecal coliform (e-coli) to Abrams and Opequon Creek will ensure that the criterion is attained.

The TMDL modelers determine the fecal coliform production rates within the watershed. Data used in the model was obtained from a wide array of sources, including farm practices in the area, the amount and concentration of farm animals, point sources in the watershed, animal access to the stream, wildlife in the watershed, wildlife fecal production rates, landuses, weather, stream geometry, etc.. The model then combines all the data to determine the hydrology and water quality of the stream.

The lands within the watersheds were categorized into specific landuses. The landuses had specific loading rates and characteristics that were defined by the modelers. Therefore, the loading rates are different in lands defined as forested versus pasture. Pasture lands support cattle and are influenced differently by stormwater runoff. The model was run using the modified weather data collected at the Star Tannery and Winchester weather stations. This data was used to determine the precipitation rates in the watersheds which transport the on land pollutants to the streams through overland and groundwater flows.

As stated above the models for Abrams and Upper Opequon Creek were calibrated to observed flow from USGS gages in the watersheds. During the calibration period the hydrology components of the model were adjusted in order to have the simulated (modeled) flow accurately represent the observed flow conditions. The models were then run and compared to a new set of observed flow conditions without adjusting the model parameters, this is known as validation and is used to insure that the model is accurately reflecting observed flow conditions. Since there was no gage on Lower Opequon Creek, the model was not calibrated to observed flow conditions. The Lower Opequon Creek model used the same parameters as the model for Upper Opequon Creek. The calibration and validation periods for Abrams Creek were 1986 through 1988 and 1980 through 1985 respectively. The Upper Opequon Creek model was calibrated to data from October 1987 through September 1992 and validated to data from October 1992 through September 1997. The water quality component of all the models were calibrated to fecal coliform samples collected within the watersheds.

2) The TMDLs include a total allowable load as well as individual waste load allocations and load allocations.

<u>Total Allowable Loads</u>

Virginia indicates that the total allowable loading is the sum of the loads allocated to land based precipitation driven nonpoint source areas (forest and agricultural land segments) and point sources. Activities that increase the levels of bacteria to the land surface or their availability to runoff are considered flux sources. The actual value for total loading can be found in Table 1 of this document. The total allowable load is calculated on an annual basis.

<u>Waste Load Allocations</u>

Virginia has stated that there are forty-nine regulated point sources discharging within the Abrams and Opequon Creek watersheds. Forty-three of these facilities are single family home units and are under a general permit, these facilities are permitted to discharge 1,000 gallons per day. These facilities are not listed individually in this rationale but can be found within the TMDL report. Two of these facilities are municipal separate storm sewer systems (MS4s), these systems are dedicated to the collection and discharge of stormwater. The two MS4 systems are the City of Winchester and Virginia Department of Transportation. The stormwater loading between these two sources could not be segregated as it is difficult to ascertain the specific roads and jurisdictions. The loading to Abrams Creek from the impervious land segments within the City of Winchester were allocated to the MS4. The remaining dischargers are traditional National Pollutant Discharge Elimination System (NPDES) permitted facilities. For the non-stormwater sources the WLA can be determined by multiplying the permitted flow by the permitted pollutant concentration which is the applicable e-coli criteria.

EPA regulations require that an approvable TMDL include individual waste load allocations (WLAs) for each point source. According to 40 CFR 122.44(d)(1)(vii)(B), "Effluent limits developed to protect a narrative water quality criterion, a numeric water quality criterion, or both, are consistent with assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA pursuant to 40 CFR 130.7." Furthermore, EPA has authority to object to the issuance of any NPDES permit that is inconsistent with the WLAs established for that point source.

Table 2 - Bacteriological (E-Coli) WLAs for Abrams and Opequon Creek

Facility Name	Permit Number	Creek	Existing Load (cfu/yr)	Allocated Load (cfu/yr)
I-81 Rest Area STP	VA0023116	Opequon	2.61E+10	2.61E+10
Opequon Regional AWT	VA0065552	Opequon	2.12E+13	2.12E+13
Perkins Mill STP	VA0075191	Opequon	3.48E+12	3.48E+12
Stonebrook Swim Club	VA0088722	Opequon	6.99E+10	6.99E+10
43 Single Family Treatment Units	General Permits	Opequon	7.49E+10	7.49E+10
MS4- City of Winchester	VAR040053	Abrams/ Opequon	3.10E+12	3.10E+12
MS4- VDOT	VAR040032	Abrams/ Opequon		

Load Allocations

According to Federal regulations at 40 CFR 130.2(g), load allocations (LAs) are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading. Wherever possible, natural and nonpoint source loads should be distinguished.

In order to accurately simulate landscape processes and nonpoint source loadings, VADEQ used the HSPF model to represent the impaired watersheds. The HSPF model is a comprehensive modeling system for the simulation of watershed hydrology, point and nonpoint source loadings, and receiving water quality. HSPF uses precipitation data for continuous and storm event simulation to determine total loading to the impaired segments from the various land uses within the watershed. Tables 3a, 3b, and 3c list the LAs for the impaired waters.

Table 3a - LA for Bacteria (fecal coliform) for Abrams Creek

Source Category	Existing Load ($x10^{12}$ cfu/yr)	Proposed Load ($x10^{12}$ cfu/yr)	Percent Reduction

Cattle Direct Deposit	4.10	2.9	29
Wildlife Direct Deposit	12.7	12.7	0.0
Cropland	6.6	6.6	0.0
Pasture	2,950	2,950	0.0
Residential	2,470	111	95
Loafing Lot	2,280	2,280	0.0
Forest	1,090	1,090	0.0
Impervious Land Segments non MS-4	257	13.3	95
Impervious Land Segments MS-4	451	19.4	96

Table 3b - LA for Bacteria (fecal coliform) for Upper Opequon Creek

Source Category	Existing Load ($x 10^{12}$ cfu/yr)	Proposed Load ($x10^{12}$ cfu/yr)	Percent Reduction
Cattle Direct Deposit	93.6	0.0	100
Wildlife Direct Deposit	13.2	0.64	95
Cropland	92.3	9.26	90
Pasture	13,600	1,360	90
Residential	2,030	258	88
Loafing Lot	297	0	100
Forest	583	583	0.0
All Impervious Land Segments	4.7	0.7	85

Table 3c - LA for Bacteria (fecal coliform) for Upper Opequon Creek

Source Category	Existing Load ($x10^{12}$ cfu/yr)	Proposed Load ($x10^{12}$ cfu/yr)	Percent Reduction
Cattle Direct Deposit	16.2	16.2	0.0
Wildlife Direct Deposit	1.8	1.8	0.0

Cropland	205	10.3	95
Pasture	21,300	1,070	95
Residential	1,300	286	78
Loafing Lot	966	0.0	100
Forest	592	592	0.0
All Impervious Land Segments	3.9	1.97	50

3) The TMDLs consider the impacts of background pollution.

The TMDLs consider the impact of background pollutants by considering the bacteria load from background sources like wildlife.

4) The TMDLs consider critical environmental conditions.

According to EPA's regulation 40 CFR 130.7 (c)(1), TMDLs are required to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of the impaired creeks is protected during times when it is most vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards[3]. Critical conditions are a combination of environmental factors (e.g., flow, temperature, etc.), which have an acceptably low frequency of occurrence. In specifying critical conditions in the waterbody, an attempt is made to use a reasonable "worst-case" scenario condition. For example, stream analysis often uses a low-flow (7Q10) design condition because the ability of the waterbody to assimilate pollutants without exhibiting adverse impacts is at a minimum.

The HSPF model was run over a multi-year period to insure that it accounted for a wide range of climatic conditions. The allocations developed in the TMDLs will therefore insure that the criteria is attained over a wide range of environmental conditions including wet and dry weather conditions.

5) The TMDLs consider seasonal environmental variations.

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[3]EPA memorandum regarding EPA Actions to Support High Quality TMDLs from Robert H. Wayland III, Director, Office of Wetlands, Oceans, and Watersheds to the Regional Management Division Directors, August 9, 1999.

Seasonal variations involve changes in stream flow and loadings as a result of hydrologic and climatological patterns. In the continental United States, seasonally high flows normally occur in early spring from snow melt and spring rain, while seasonally low flows typically occur during the warmer summer and early fall drought periods. Bacteria loadings also change during the year as vegetation grows and waste application rates and cattle access to the stream change seasonally. Consistent with our discussion regarding critical conditions, the HSPF model and TMDL analysis effectively considered seasonal environmental variations through the use of observed weather data over an extended period of time and modifying the soil loss equations based on the time of the year.

6) The TMDLs include a margin of safety.

This requirement is intended to add a level of safety to the modeling process to account for any uncertainty. The MOS may be implicit, built into the modeling process by using conservative modeling assumptions, or explicit, taken as a percentage of the WLA, LA, or TMDL. Virginia included an implicit MOS in the TMDL through the use of conservative modeling assumptions in the determination of bacteria loadings and production.

7) There is a reasonable assurance that the TMDLs can be met.

EPA requires that there be a reasonable assurance that the TMDLs can be implemented. WLAs will be implemented through the NPDES permit process. According to 40 CFR 122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA. Furthermore, EPA has authority to object to issuance of an NPDES permit that is inconsistent with WLAs established for that point source.

Nonpoint source controls to achieve LAs can be implemented through a number of existing programs such as Section 319 of the CWA, commonly referred to as the Nonpoint Source Program.

The TMDLs in their current form are designed to meet the applicable water quality standards. The Commonwealth intends to implement these TMDLs through best management practices (BMPs). The implementation of these practices will occur in stages. This will allow the Commonwealth to monitor the benefits of the BMPs and determine which practices have the greatest impacts on water quality. It will also provide a mechanism for developing public support and checking the accuracy of the model.

8) The TMDLs have been subject to public participation.

The first public meeting for Abrams Creek was held on March 13, 2003 at Shenandoah University in Winchester, Virginia. The first public meeting for Lower Opequon Creek was held on April 3, 2003 at same location. Both meeting were attended by 45 people and had a thirty-day comment. A final public meeting to address the bacteriological TMDLs was held at Shenandoah University on July 8, 2003 at Shenandoah University. Approximately 11 people attended the meeting and the comment period closed August 07, 2003.